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CRITICISM OF THE ENGINEERING SCHOOLS[1]

FRANCIS BACON said in the introduction to his "Maxims of the Law":

> I hold every man a debtor to his profession; from the which as men, of course, do seek to receive countenance and profit, so ought of duty to endeavor themselves by way of amends to be a help and ornament thereunto.

This quotation is so enriched by age that it can be constantly quoted without attracting the charge of being trite; and its meaning is particularly apposite to my subject. I press it upon your attention the more willingly because teachers and professional men generally are given to overlooking the importance of its precept. An engineering school has a hard duty, for it must teach science and business, humanity and common sense, and withal it must give its students professional ideals. The present is a period of discussion and adjustment of the relationships of engineering courses to the preparatory schools and to the so-called liberal college courses. Various of our universities are setting up requirements for entrance into their engineering courses which include a part of the subjects leading more particularly to the bachelor of arts degree; and one of our greatest universities has made the possession of a bachelor of arts or equivalent degree the prime requirement of entrance into the studies of its engineering school, and has called its school a "graduate school of engineering." The adopted name for that school seems to me a misnomer, for the major portion of its teach-

[1] Lecture before the Stevens Engineering Society, November 23, 1909.

ing must be substantially of the same nature as that done in the undergraduate classes of the Stevens Institute of Technology and many other engineering schools, while engineering graduate study has come to be accepted in engineering circles as more advanced study of the sciences and their relations than can be pursued under limitations of time and subject matter pertaining to teaching classes rather than individuals. Whatever objections may be associated with the chosen name, "graduate school of engineering" for the particular work to be there done, it is an undoubted fact that the agitation accompanying the reorganization of the engineering courses of Harvard University and the establishment of the new school has been serviceable to the cause of engineering education. Even the chosen name has emphasized the effect by giving an impression of the extent and depth required in an adequate engineering education which has never before been grasped by the American public.

How many of you young men, students of engineering, composing this audience have reflected upon the meaning of the profession which you are intending to follow, or of the duties which are associated with it? How many of you have in mind a clear-cut definition of the character of the mental processes used by experienced engineers in executing their duties? How many of you have a clear recognition of the distinctions of mind and method which compose the differences between an engineer and a well-educated mechanic of unusual skill? You must reflect on all of these points and come to adequate convictions before you can become of the ablest and most distinguished ranks of engineers. These things can be organized in one's mind only by the thoughtful reflection which arouses the imagination. Thoughtful reflection is, to paraphrase Lowell, as needful for the imagination as society is wholesome for the character; and an engineer's education can be scarcely begun until he learns that an exact and truthful imagination is one of his most important professional possessions.

France seems to be the only one of the civilized nations in which the engineers are given a full professional recognition. In Great Britain the machinists at the bench divide with the professional men the name "engineer," and when a great machinists' strike occurs the newspapers herald it with large headlines as the "strike of the engineers"; but who ever heard of professional men on strike? Many things occur as matters of commonplace in the average of human life that are unthinkable as parts of the lives of professional men.

Personally, I do not sympathize with requiring all young men who wish to enter an engineering school to first spend three or four years in obtaining a degree of bachelor of arts. President David Starr Jordan one time said in his apt way, "It is the business of the college to give the young man the secret of power. It should train him to be efficient, self-reliant and capable of team work to make the most of his actual abilities in the conduct of life." This applies equally to the engineering school and the so-called liberal college, and there is no exclusive hold on this important business possessed by either. If we must contrast the two, it may be seriously enquired whether the engineering schools have not in this respect usefully occupied a position formerly occupied by the liberal colleges but partially relinquished by them with the general adoption of elective courses of study unaccompanied by adequate advice and guidance—compulsion, if need be—which would lead the students to choose their studies with logic and reason.

But we must also remember that a truly influential man must know something of literature, biography, history, art and music. He must be a man of complete living. "To prepare us for complete living," Herbert Spencer said in his interesting book on education, "is the function which education has to discharge; and the only rational mode of judging of any educational course is to judge in what degree it discharges such function." Spencer also defines what he means by complete living, and every able, reflecting man may give a similar definition out of his own consciousness and experience: An education for complete living includes training the faculties of self-preservation, the faculties of self-support, the faculties of the domestic life and proper parentage, the faculties of good citizenship including interest and activity in the betterment of our political and social relations, the faculties of properly enjoying one's leisure and lending enjoyment to others.

The study of science and its applications as carried on in the atmosphere of our better engineering schools may surely be made an important stimulus to each of the powers and faculties which are required for complete living. It has been asserted that it lends itself more particularly to the earlier and less disinterested ones; but that this is necessary I must deny. The profession of the engineer demands a creative imagination cultivated to the sober clear sight which sees things as they are, and from which springs an appreciation of art, literature and music which rivals that produced in any other manner. But the physical sciences and their applications, even when coupled with desirable dilettantism, are not adequate to the requirements of engineering in its broadest sense; and the political and social sciences must be added to the list.

In this latter respect most of our engineering curricula have been startlingly deficient. I even lay the charge at the door of your own great institute; an institute which has instructed the spirit of many who have become of the nation's leading engineers. Will you look through that list of distinguished engineers and tell me how many have become notable for activities in the political and social affairs of the nation? We can count to your credit your distinguished alumnus and president and a few others of corresponding public spirit, but they are few when noted in comparison with the importance of the engineer's work in civilization and civic life and the important influence which this institute has borne in American engineering. Remember that the existence of civilization as we know it, and to a large degree its advancement, depend upon transportation and intercommunication, which are fundamentally engineering industries. Are the engineers then to allow those important political and civic activities which cling around civilized life to fall under the sole direction of others?

It is an easy answer to say that the engineers are too busy in working and directing the economic advances of civilization to afford attention to the way in which political and civic activities are guided; but this answer is inadequate. The lawyers, the physicians, the merchants are also busily engaged in affairs of importance, in their kind, and they might make a similar excuse for abstaining from political and social activity; in which case, I think we must all admit, our forms of government would soon break down from want of adequately trained and disinterested leaders.

It seems to me, gentlemen, that this rather general failure of the engineering graduates to keep a wide-open eye on the political activities of our land is a serious

fault that must be laid at the door of our education. Why is it that the professors of philosophy, literature and allied subjects in Columbia University are recognized as in interest with, or active forces in, the movements for civic good in New York City, while its professors of engineering are not counted in the same ranks, however great may be their unexpressed individual interest? Why is it that the professors of engineering in Harvard University and the Massachusetts Institute of Technology are constantly called on for expert engineering advice relating to the affairs of city and commonwealth, but are not found in relatively as important association with movements relating to the political welfare of the same portions of society? This is obviously not due to the fact that engineers are not experts in sociology and political economy, because that fact equally applies to the lawyers, physicians, bankers and merchants who take notable parts in such activities. It can be explained only on the ground of lack of interest taken in such questions by engineers individually and as a class. This leaves the profession without color of impression on such activities. That this is a fault which may be corrected is apparent when one thinks of the number of graduates of the Polytechnic School in France who have not only become distinguished in science and engineering, but have also made strong impression on the nation's affairs. The query at once arises—Have the engineering school curricula in this country been adequate in this particular, and have they brought to their students the breadth of human vision and the altruistic motives required for these activities? If this query is not answerable in the affirmative, we must look earnestly for the most appropriate way of correcting our defect. Having scrutinized a situation and discovered a defect, engineers find that duty demands that a plan be devised to correct the error.

Have we the error and are we devising a useful plan to correct it? Some not only urge the error's existence, but also advocate a liberal college course antecedent to the engineering course as its cure. The appeal of this plan seems to take strongly with educated people so that the number of college graduates in the junior and senior classes of our better engineering schools is steadily increasing. Forty per cent. of the young men graduating from the electrical engineering course of the Massachusetts Institute of Technology last June had previously graduated from college and thereafter spent from two to three years in the study of electrical engineering at that Institute. I believe this is a good token and that the tendency is to be encouraged; but I do not believe that this is the only way to arrive at the results that we desire, or that without careful cooperation it is sure to produce the desired results. We must first take needed precautions to bring the studies into their logical relations in the curricula and to prevent too great time being occupied in the double course. It would be unfortunate for all our engineering students to be prevented from completing their studies and getting into the experiences of their earlier engineering employments until their twenty-fifth year had been entered or even passed. Circumstances now make that necessary for many of our students, and it is undesirable to add requirements which would make it necessary for all of our students. The particularly able may most readily carry the handicap of entering their professional service late, but some at least of them ought to have the opportunity of true graduate study, that is, advanced study of engineering sciences, before they have gone beyond their twenty-fifth year.

Under these conditions it seems desirable that some more effective correlation of the liberal and professional curricula, using the terms liberal and professional in their usual but rather narrow significance, should be devised than can be obtained by putting them end to end. A butt joint does not appeal to an engineer as a desirable arrangement for use where a well-knit and smooth splice is needed. Something better must be devised. A joint five-year course of elective groups would apparently meet the requirements and could be arranged by cooperation between educational institutions. Whatever the plan, however, economic subjects ought, in my opinion, be given a place alongside of and in close relation to the professional scientific studies.

However well a man knows the physical and mathematical sciences, he can not make the most of his abilities as an engineer unless he also understands the human character and the trend of human progress. The study of historical and economic subjects is of an importance in the engineering curriculum that rivals the study of science subjects; and in order that the relations to each other of engineering science and political economy may be understood and appreciated by the students, the study of such subjects may preferably be carried on side by side. A span of horses makes a more effective team for cooperative work than a tandem pair, though it may not be so showy.

I do not propose here to discuss the question much argued in some educational circles of what qualities makes one study "liberal" and another study "professional." Personally, I believe that most studies are "liberalizing" when studied with a spirit of enthusiasm, seeking for thoroughness and the reception of truth, at least when accompanied by that reflective consideration which makes for imagination; and the same spirit is needed to make any study of much value as a preparation for a profession. Highly developed powers of observation and induction go far to determine a man's success in most professional branches, and also in those branches of business that count. That is a collateral reason why chemistry, physics, mathematics and applied mechanics are such important studies for engineers. They teach their disciples to observe closely and accurately and to draw correct conclusions. An industrial engineer must also know the thoughts of the world, the flux of society, the ambitions of nations. He can not be a "hermit wrapped in the solitude of his own originality," but must have broadly humanistic sentiments and sympathies. These facts being obvious, what truly humanistic studies can we rightfully exclude from the list useful as preparation for engineering professional life? Our solicitude need only be exercised to see that sufficient of the mathematical and physical sciences, the historical and economic studies, and the languages make constituent parts of the curriculum, and that the spirit and order in which these are studied are right. It is probably in the latter that we are erring. The sciences, historical and economic studies, and languages are well represented in the curricula of many of our engineering schools, but there is a failure to impress on the mind of the student that the economic subjects are intimately related with the work of his profession. Perhaps here lies the explanation of the apparent failure of engineers to play their reasonable share in civic affairs. If that is the explanation, our methods of teaching ought to be promptly reformed.

Another serious fault has been charged against the graduates of the engineering schools as they come newly from the

schools, and this is an unwillingness or inability to work faithfully in cooperative organization with others. This fault has been trenchantly presented by your very distinguished alumnus Mr. Frederick W. Taylor, and he ascribes it to an overesteem and a lack of seriousness on the part of newly made graduates. The lack of seriousness I am not now ready to admit, and I think the fault more likely to be caused by the failure of our instruction to inform students of the tremendous importance of cooperative effort and common-sense business processes in industrial life. It is true that the same fascination as heretofore lingers around independence in spirit and in work, but industrial affairs have grown so large and complex that a man can not singly make a large influence. Cooperation with others is necessary—loyal cooperation. The conditions of the old-time one-man shop have passed away, probably forever. However high up a man may now go, he must cooperate cordially and loyally with associates, and they and their subordinates must cooperate loyally with him. It is said of Napoleon that, "Grand, gloomy and peculiar, he sat upon the throne a sceptered hermit, wrapped in the solitude of his own originality"; and Napoleon was an influence of tremendous effect. But historians point out that even Napoleon finally failed from lack of cooperation. However forceful, however original, a man may be, and however far he may go by his own unaided mind and effort, well-planned cooperative effort of lesser men can always accomplish his defeat. Also, besides the pervading importance of personal cooperation, students must learn the importance of cooperative or associate use of the mental processes gained from their study of science and from the dictates of common business sense. Some electric light plants make money because they are operated in accordance with principles of sound science and economics; others make money because they are managed with admirable business sense, though it may be without conscious guidance of science or economics; but in relatively few are found the invincible association of sound engineering with sound business sense.

Mr. Taylor's proposal that each student should be required to spend a year or more in commercial shop employment before the end of his course of study in the engineering school would do much to correct this fault. It is to be welcomed as a constructive suggestion in reference to the curricula of the engineering schools; but I believe much can be accomplished by improving the processes used in teaching, without changing the curriculum. Teachers and students when pursuing learning both become so absorbed in the pursuit as to forget the end sought. The result desired may be accomplished largely by the influence of the teachers, by the character of the treatment of the students and by the sort of ambitions that are put into them. It can be done in some degree by the selection of the work assigned to the curriculum, but the subjects studied, in my opinion, are of less importance than that the students learn (as Kipling puts it):

> Truth, and God's own Common Sense.

In thus discussing certain faults of the curricula of the engineering schools with this audience, which I understand to be largely composed of the students of this Institute, I take the ground that it is desirable for students as well as faculties to recognize, reflect on and understand the human shortcomings of the courses of training. By no other means, it seems to me, can earnest students be stimulated to make the most of their opportunities and belie the charge of inefficiency that is sometimes laid at the door of engineering grad-

uates. I think there is no doubt that the engineering courses make the best preparation for engineering and industrial life that has been devised. Good engineers lived before the engineering schools; but the engineering schools are doing a tremendous work in providing men with the mental means to extend engineering knowledge and advance engineering practise.

One of the things that students, to their disadvantage, commonly fail to keep constantly in mind is the fact that a man of ability and courage can usually make of himself that which his ambitions dictate. If you set your ambitions right there need be no fear of your reasonable success. Failure by a man of ability and courage, who also has the advantage of education, is scarcely to be condoned. The only sufficient excuse is an inadequate physique or ill health caused through no fault of the individual. In engineering nothing is ordinarily sufficient to excuse failure.

Samuel Lover says in his humorous but human story of Rory O'More:

> Now, it was not merely luck was on Rory's side, for he turned all the accidents to good account, which would have been thrown away on a fool; and this, after all, is what makes the difference in ninety-nine cases out of every hundred between a lucky and an unlucky man. The unlucky man often plays life's game with good cards and loses; while the lucky man plays the same game with bad ones and wins. Circumstances are the rulers of the weak—they are but the instruments of the wise.

If a man concentrates his efforts, is honest, is patient, performs his duties with thoroughness, masters the principles relating to his employment, and thinks (it is remarkable "how many never think, who think they do"), he is sure to succeed. True success is a great achievement, and great achievements require long expenditure of well-directed endeavor for their erection. It is a restlessness and discontent born of a failure to note the last precept, often accompanied by an excessive self-esteem, which leads to Mr. Taylor's criticism of engineering graduates to which I have previously referred. For the cure of that I will refer you to Kipling. He says in a burst of autobiographical confidence:

> As there is only one man in charge of a steamer, so there is but one man in charge of a newspaper, and he is the editor. My chief taught me this on an Indian journal, and he further explained that an order was an order, to be obeyed on a run, not a walk, and that any notions as to the fitness or unfitness of any particular kind of work for the young had better be held over until the last page was locked up to press. He was breaking me into harness and I owe him a debt of gratitude which I did not discharge at that time. The path of virtue was very steep, whereas the writing of verses allowed a certain play to the mind, and, unlike the filling in of reading matter, could be done as the spirit served. Now, a sub-editor is not hired to write verses; he is paid to sub-edit. At the time, this discovery shocked me greatly; but some years later, when I came to be a sort of an editor-in-charge Providence dealt me for my subordinate, one saturated with Elia. He wrote very pretty Lamblike essays, but he wrote them when he should have been sub-editing. Then I saw a little of what my chief must have suffered on my account. There is a moral here for the ambitious and aspiring who are oppressed by their superiors.

If every young engineering school graduate who becomes discontented with his duties and the treatment he receives would read, ponder and reflect on these words of Kipling, which express his youthful experiences, I believe Mr. Taylor would have few opportunities to repeat his criticism of the new graduates from engineering schools.

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DOCTORATES CONFERRED BY AMERICAN UNIVERSITIES

THERE are given in the accompanying tables data in regard to the degrees of doc-

TABLE I

Doctorates Conferred

	Average of 10 Years 1898–1907	1908	1909	1910	Total for 13 Years 1898–1910
Chicago	35.6	54	38	42	490
Columbia	32.2	55	59	44	480
Harvard	33.8	42	38	35	453
Yale	31.8	32	44	27	421
Johns Hopkins	30.5	28	27	23	383
Pennsylvania	22.5	32	29	26	312
Cornell	18.1	22	34	35	272
Wisconsin	8.6	17	16	18	137
Clark	8.7	11	9	14	121
New York	6.7	15	13	11	106
Michigan	6.9	4	13	7	93
Boston	4.4	11	13	6	74
California	3.3	4	10	6	53
Princeton	2.6	6	4	8	44
George Washington	2.8	3	4	4	39
Minnesota	2.4	3	5	1	33
Virginia	2.8	4	1	0	33
Bryn Mawr	2.1	4	2	5	32
Brown	2.3	2	5	1	31
Catholic	2.0	1	3	3	27
Illinois	.5	5	4	12	26
Nebraska	2.0	2	2	1	25
Stanford	1.4	2	3	5	24
Iowa	1.1	2	0	4	17
Georgetown	1.0	0	0	0	10
Vanderbilt	.6	1	1	2	10
Missouri	.4	3	0	2	9
Massachusetts Institute	.3	3	0	3	9
Washington	.7	1	0	0	8
Cincinnati	.3	0	2	2	7
Pittsburgh	.1	4	0	2	7
Colorado	.5	0	1	0	6
Indiana	.0	3	3	0	6
Kansas	.3	0	0	3	6
North Carolina	.5	0	1	0	6
Northwestern	.4	0	1	0	5
Syracuse	.2	0	2	1	5
Washington and Lee	.4	1	0	0	5
Lafayette	.3	0	0	0	3
Dartmouth	.1	1	0	0	2
Lehigh	.2	0	0	0	2
Tulane	.1	0	0	0	1
Total	271.5	378	387	353	3,833

TABLE II

Doctorates Conferred in the Sciences

	Average of 10 Years 1898–1907	1908	1909	1910	Total for 13 Years 1898–1910	Per Cent.
Chicago	16.4	37	20	24	245	50
Johns Hopkins	16.8	17	20	15	220	57
Columbia	13.4	21	23	11	189	39
Yale	12.4	16	27	12	179	43
Harvard	14.1	13	14	10	178	39
Cornell	10.4	15	24	27	170	63
Pennsylvania	9.0	18	13	12	133	43
Clark	7.7	11	8	14	110	91
Wisconsin	2.8	6	4	13	51	37
California	2.4	2	6	4	36	68
Michigan	2.9	1	5	1	36	38
George Washington	1.7	2	2	3	24	62
Princeton	1.1	3	3	2	19	43
Brown	1.2	2	2	1	17	55
Nebraska	1.3	1	2	1	17	68
Stanford	1.1	2	2	1	16	67
Illinois	.3	0	2	9	14	54
Virginia	1.1	2	0	0	13	42
Bryn Mawr	1.0	1	0	2	13	40
New York	.6	1	3	2	12	11
Minnesota	.7	1	2	1	11	33
Iowa	.7	0	0	2	9	52
Massachusetts Institute.	.3	3	0	3	9	100
Washington	.7	1	0	0	8	100
Catholic	.5	—	2	0	7	26
Missouri	.3	2	0	2	7	78
Indiana	.0	3	3	0	6	100
Kansas	.3	0	0	3	6	100
North Carolina	.3	0	1	0	4	66
Vanderbilt	.3	1	1	0	5	50
Washington and Lee	.3	1	0	0	4	80
Cincinnati	.1	0	1	1	3	43
Northwestern	.2	0	1	0	3	60
Boston	.1	0	1	0	2	3
Colorado	.2	0	0	0	2	33
Dartmouth	.1	1	0	0	2	100
Lehigh	.2	0	0	0	2	100
Syracuse	.1	0	0	1	2	40
Georgetown	.1	0	0	0	1	10
Lafayette	.1	0	0	0	1	33
Pittsburgh	—	—	—	1	1	14
Total	123.3	184	192	178	1,787	47

tor of philosophy[1] conferred by the universities of the United States, which are now collected for the thirteenth consecutive year. There were conferred this year 353 degrees, not so many as in the three preceding years, when the numbers were 366, 378 and 387. A fluctuation of this character is not significant, though it is certainly the case that the increase in the number of degrees is smaller than might be hoped and might be expected. There is no change in the order of the leading universities in respect to the number of degrees that they have conferred. Chicago

[1] One doctorate of science from New York University and one doctorate of engineering from the Massachusetts Institute of Technology are included.

TABLE III

	Average of 10 Years 1898–1907	1908	1909	1910	Total for 13 Years 1898–1910
Chemistry	32.0	54	42	48	464
Physics	15.5	22	25	25	227
Zoology	14.7	25	18	24	214
Psychology	13.4	23	21	20	198
Mathematics	12.1	23	13	23	180
Botany	12.6	11	16	10	163
Geology	7.1	5	13	10	99
Physiology	4.1	7	13	4	65
Astronomy	3.4	1	7	2	44
Agriculture	1.0	2	7	4	23
Bacteriology	1.4	1	5	1	21
Anthropology	1.0	4	4	2	20
Paleontology	1.6	1	0	2	19
Anatomy	.9	2	0	1	12
Pathology	.5	2	3	1	11
Mineralogy	.6	0	3	0	9
Engineering	.8	0	0	1	9
Metallurgy	.3	0	1	0	4
Geography	.1	1	1	0	3
Meteorology	.1	0	0	0	1
Total	123.3	184	192	178	1,787

	1908	1909	1910	Total for 3 Years
English	30	27	30	87
History	32	22	24	78
Economics	17	42	6	65
Philosophy	25	14	19	58
German	14	14	16	44
Latin	12	12	15	39
Oriental Languages	9	15	11	35
Romance	12	16	6	34
Greek	13	11	4	28
Education	6	9	13	28
Sociology	6	6	14	26
Political Science	9	4	9	22
Theology	7	2	1	10
Philology and Comparative Literature	0	1	5	6
Law	1	0	1	2
Music	1	0	1	2
Total	194	195	175	564

still stands first, having granted 490 degrees in the course of the past thirteen years. Columbia follows closely with 480, and there then follow Harvard with 453, Yale with 421, Johns Hopkins with 383, Pennsylvania with 313 and Cornell with 271. There is then a considerable drop to Wisconsin, Clark, New York and Michigan. The most notable fact in regard to last year is the conferring of twelve degrees by Illinois, nearly as many as in the preceding twelve years. Wisconsin, by conferring 18 degrees, also maintains the position which it has recently assumed. These two institutions this year surpass Michigan with 7 degrees, California with 6 degrees, and Minnesota and Nebraska with one degree each, these being the six state universities in which graduate work is the most developed.

Almost exactly half the degrees conferred last year were in the natural and exact sciences. The universities, however, differ considerably in the relative importance of their work in the sciences. Chicago appears to be the best balanced; it has conferred just half its degrees in the sciences and half in other subjects. At the Johns Hopkins and Cornell about sixty per cent. of the degrees are in the sciences, whereas the percentage is about forty at Harvard, Yale, Columbia and Pennsylvania. There is not a preponderance of the sciences in the state universities, the percentage of degrees at Wisconsin being only 37 and at Michigan 38. Boston University appears to have the most curious record, having conferred only three scientific degrees out of seventy-four. There was this year a large fall in the number of degrees in the sciences conferred by Columbia, 11 as compared with 21 and 23 in the two preceding years. Cornell, on the other hand, conferred this year 27 degrees in the sciences, surpassing all other institutions.

Table III. gives the distribution of the degrees among the different subjects. Chemistry, with 48 degrees, leads, as always, having about double the numbers in

physics, zoology, psychology and mathematics. Botany comes next and there is then a considerable drop to geology, followed by physiology and astronomy. In the case of the subjects not ranked under the natural and exact sciences, most degrees have been given in English, history, economics and philosophy. The number of degrees in the languages appears to be small, when the large number of teachers in these subjects in our colleges and schools is considered. Teachers of French and German are, however, largely foreigners, and Americans who study these subjects would perhaps be more likely than others to take their degrees abroad.

The institutions which this year conferred two or more degrees in a science are: in *chemistry,* Chicago, 8; Johns Hopkins, 7; Illinois, 6; Wisconsin and Yale, 5 each; Cornell and Pennsylvania, 4 each; Columbia, 3; Harvard, 2; in *physics,* Cornell, 6; Chicago, 4; Clark and Pennsylvania, 3 each; Illinois, 2; in *zoology,* Cornell, 4; Columbia and Johns Hopkins, 3 each; California and Harvard, 2 each; in *psychology,* Clark, 9; Cornell and Harvard, 3 each; in *mathematics,* Chicago, 4; Cornell, Harvard, John Hopkins, Kansas, Princeton and Yale, 2 each; in *botany,* Cornell, 3; Pennsylvania and Wisconsin, 2 each; in *geology,* Wisconsin, 3; in *physiology,* Chicago, 3; in *agriculture,* Cornell, 2; in *anthropology,* Columbia, 2.

The names of those on whom the degree was conferred in the natural and exact sciences, with the subjects of their theses, are as follows:

CORNELL UNIVERSITY

James Theophilus Barrett: "Studies of some Phycomycetes."

James Chester Bradley: "The Wings of Hymenoptera, with particular reference to the Ichneumon Flies."

Harry Bates Brown: "The Form and Structure of certain Plant Hybrids as compared with the Form and Structure of their Parents."

Ormond Butler: "A Study of Gummosis of *Prunus* and *Citrus,* with Observations on Squamosis and Exanthema of the *Citrus.*"

Helen Maud Clarke: "Conscious Attitudes."

Harold Bartlett Curtis: "Hyperabelian Functions Expressible by Theta Series."

George Charles Embody: "The Ecology, Habits and Growth of the Pike (*Esox lucius*)."

Clarence Errol Ferree: "An Experimental Examination of the Phenomena usually attributed to Fluctuation of Attention."

Otis Amsden Gage: "The Point Discharge in Air for Pressures greater than One Atmosphere."

Roswell Clifton Gibbs: "The Effect of Temperature on Fluorescence and Absorption."

Horace Wadsworth Gillett: "Temperature Measurements in an Experimental Carborundum Furnace."

Harry Alexis Harding: "The Constancy of certain Physiological Characters in the Classification of Bacteria."

Leonard Haseman: "Structure and Metamorphosis of the Alimentary Canal of the Larva of *Psychodaal ternata* Say."

Eugene Peter Humbert: "A Biometrical Study of Variation, Natural and Induced, in Pure Lines of *Silene noctiflora.*"

Harriett Marie Martin: "An Orchard Survey of Ontario County, New York."

Fred A. Molby: "The Effect of Low Temperatures upon the Rotatory Power of the Optically Active Substances."

George William Nasmith: "Undamped High Frequency Oscillations in Radiotelegraphy and Radiotelephony."

Tamekichi Okabe: "The Psychology of Belief."

Helen Brewster Owens: "Conjugate Line Congruences of the Third Order defined by a Family of Quadrics."

Edwin Frederick Rathjen: "The Picrates of the Rare Earths."

Floyd Karker Richtmyer: "On the Photo-electric Effect as exhibited by the Alkali Metals."

Jacob Parsons Schaeffer: "The Lateral Wall of the Cavum Nasi in Man."

Fred Floyd Shetterly: "On the Oxidation of Hydrazine."

William Henry Shideler: "The Evolution of the North American Spirifers."

Albert Alexander Somerville: "The Electrical Resistance of Metals at High Temperatures."

Charles John Triggerson: "A Study of *Dryaphanta erinacæi.*"

Gorrell Robert White: "The Electrolytic Corrosion of some Metals."

UNIVERSITY OF CHICAGO

Ernest Anderson: "The Action of Fehling's Solution on d-Galactose."

Francis Christian Becht: "The Concentration of Hempronius and related Hadeis in the various Body Fluids of Normal and Immune Animals."

Charles Brookover: "The Olfactory Nerve, the Nervus Terminalis and the Preoptic Sympathetic System in *Amia Calvia* Linn."

Herbert Horace Bunzel: "The Mechanism of the Oxidation of Glucose by Bromine."

Benjamin Franklin Davis: "The Immunological Reaction of Blastomycosis."

James Richard Greer: "The Concentration of Bacterial Opsonins and Related Bodies in the various Body Fluids of Normal and Immune Animals."

William Ross Ham: "Polarization of Roentgen Rays."

William Weldon Hickman: "The Catalysis of Imido-Esters."

Theophil Henry Hildebrandt: "A Contribution to the Foundations of Frechet's Calcul Fonctionnel."

John Mathias Kuehne: "The Electrostatic Effect of a Changing Magnetic Field."

Winford Lee Lewis: "The Action of Fehling's Solution on Maltose."

Harris Franklin MacNeish: "Linear Polars of the k-hedron in n-space."

Walter Joseph Meek: "Physiological Restoration and Anatomical Regeneration of the Small Intestine after Transection."

Alan Wilfrid Cranbrook Menzies: "Studies in Vapor Pressure."

Egbert J. Miles: "The Absolute Minimum of a Definite Integral in a Special Field."

Anna Johnson Pell: "Biorthogonal Systems of Functions with Applications to the Theory of Integral Equations."

Peter Powell Peterson: "Stereoisomerism of Chlorimidoketones."

Charles Albert Proctor: "Variation of e/m with Velocity of Cathode Rays."

Lemuel Charles Rayford: "Chlorimido Quinones."

Newland Farnsworth Smith: "The Effect of Tension on Thermal and Electrical Conductivity."

Herman Augustus Spoehr: "On the Behavior of the Ordinary Hexoses towards Hydrogen Peroxide in the Presence of Alkaline Hydroxides as well as of various Iron Salts."

Arthur Howard Sutherland: "Word Association Reactions: A Contribution to the Analysis of Ideational Complexes."

Edith Minot Twiss: "Prothallia of *Aneimia* and *Lygodium*."

Joseph Bertram Umpleby: "Geology and Ore Deposits of the Republic District, Washington."

JOHNS HOPKINS UNIVERSITY

Oscar Ellis Bransky: "The Diffusion of Crude Petroleum through Fuller's Earth."

William Henry Brown: "The Development of the Ascocarp of *Lachnea Scutellata*."

William Mansfield Clark: "A Contribution to the Investigation of the Temperature Coefficient of Osmotic Pressure—A Redetermination of the Osmotic Pressures of Cane Sugar Solutions at 20°."

Arthur Howard Estabrook: "Effect of Chemicals on Growth in *Paramecium*."

Rogers Harrison Galt: "The Cathode-ray Fluorescence of Sodium Vapor."

Benjamin Harrison Grave: "Anatomy and Physiology of *Atrina* (*Pinna*) *rigida* Dillwyn."

Joseph Ellis Hodgson: "Orthocentric Properties of the Plane Directed N-Line."

Henry Royer Kreider: "The Dissociation of Electrolytes in Non-aqueous Solvents as determined by the Conductivity and Boiling-point Methods."

Homer Payson Little: "The Physical Features of Anne Arundel County, Maryland."

Sylvester Kline Loy: "The Reactions of Sodium Ethylate with Alkyl Halides."

Chester Newton Myers: "Deposition of Copper Ferrocyanide Membrane by the Electrolytic Method."

Henry Clarence Robertson, Jr.: "The Reactions of Alkyl Halides with Sodium Phenolate."

Joseph Eugene Rowe: "A Complete System of Invariants for the Plane Rational Quartic Curve, and other Facts in regard to Rational Curves."

George Frederic White: "The Conductivity and Dissociation of Organic Acids in Aqueous Solution at different Temperatures."

Charles Branch Wilson: "The Development of *Achtheres ambloplitis* Kellicott."

CLARK UNIVERSITY

Rudolph Acher: "Psychology and Hygiene of Sex."

Harry Woodburn Chase: "Psycho-analysis and the Unconscious."

Elnora Whitman Curtis: "The Dramatic Instinct in Education."

Hobert Cutler Dickinson: "Combustion Calorimetry and the Heats of Combustion of Cane Sugar, Benzoic Acid and Naphthalene."

William Trowbridge Merrifield Forbes: "A Structural Study of some Caterpillars."

Gordon Scott Fulcher: "Experiments on the Intensity of Light from Canal Rays."

William Henry Holmes, Jr.: "The Adjustment of School Organization to the Needs of the Individual Child."

George Alexander Hutchinson: "Psychology of Symbolism."

Raymond Kurtz Morley: "On the Fundamental Postulate of Tamisage."

Thomas Lansing Porter: "Experiments on a New Dynamical Method for the Study of Elastic Hysteresis."

Leroy Walter Sackett: "The Canada Porcupine: A Study of the Learning Process."

George Henry Steves: "Industrial Education of Boys and Girls."

John Howard Stoutemyer: "A Comparative Study of Mission Methods."

Edward Ebenezer Weaver: "Psycho-therapeutic Evangelism."

UNIVERSITY OF WISCONSIN

Ruth Florence Allen: "Studies in Spermatogenesis and Apogamy in Ferns."

Sydney Hobart Ball: "General Geology of Georgetown (Colorado) Quadrangle."

Raymond Calvier Benner: "The Fractionation of the Yttrium Earths by Means of the Succinates."

James Miller Breckenridge: "Calcium Alloys."

Francis Todd H'Doubler: "On certain Functional Equations."

Charles Warren Hill: "The Separation of the Gadolinium Earths as Stearates."

David Klein: "On the Interaction of Hydrogen Sulphide of Sulphur Dioxide."

Francis Craig Krauskopf: "Vapor Pressure of Water and Sodium Chloride Solutions."

Benjamin Franklin Lutman: "Some Contributions to the Life History and Cytology of the Smuts."

Henry Herman Paul Severin: "A Study on the Structure of the Egg of the Walking Stick, *Diapher omera femorata* Say; and the Biological Significance of the Resemblance of the Phasmid Egg to Seeds."

Edward Steidtmann: "The Origin of Dolomite."

Earle Melvin Terry: "The Effect of Temperature on the Magnetic Properties of Electrolytic Iron."

Wendell Garrett Wilcox: "Studies in Osmotic Phenomena."

UNIVERSITY OF PENNSYLVANIA

Maurice Jefferis Babb: "The Second Category of the Groups of Order 2^m which contain Self-conjugate Cyclic Subgroups of Order 2^{m-4}."

Walter Martinus Boehm: "A Method of Measuring the Intensity of Sound."

Glenn Vinton Brown: "The Determination of Manganese."

Gideon Stanhope Dodds: "Segregation of the Germ Cells of the Teleost *Lophius*."

Daniel Roberts Harper, 3d: "Vacuum Jacketed Calorimeter and the Specific Heat of Copper."

Dicran Hadjy Kabakjian: "The Silent Discharge and the Formation of Ozone."

John Hughes Müller: "The Behavior of the Metallic Acids with Salicylic Acid."

George William Plummer: "The Chemical Constitution of Marcasite and Pyrite."

Dâmaso Rivas: "Bacteria and other Fungi in Relation to the Soil."

Aaron Moyer Snyder: "A Statistical Analysis of the Retardation and its Causes in the Reading, Pennsylvania, Public and Parochial Schools."

Elmer Bixler Ulrich: "Leaf Movements in the Family Oxalidaceæ."

Calvin Naftzinger Wenrich: "A Study in the Time Interval in a Productive or Circuit Breaking Device."

YALE UNIVERSITY

Edward Monroe Bailey, Jr.: "Biochemical and Bacteriological Studies on the Banana."

Alice Frances Blood: "The Proteolytic Enzymes in certain Plants."

DeLorme Donaldson Cairnes: "The Wheaton River District, Yukon Territory, Canada."

David Breese Jones: "The Conversion of Halides of the General Formula—X. CH_2, CH hal. CH_3—into Allyl and Propenyl Compounds."

John Kenyon Lamond: "Improper Multiple Integrals depending on a Parameter."

Ralph Walter Longley: "Studies of the Oxides of Tantalum and Columbium."

William Harding Longley: "The Maturation of the Egg and Ovulation in the Domestic Cat."

Edwin Cyrus Miller: "A Physiological Study of the Germination of *Helianthus annuus*."

Howard Earle Palmer: "The Use of Potassium Ferrocyanide and Potassium Ferricyanide in Analysis."

Chester Albert Reeds: "The Stratigraphy of the Hunton Formation, with Introductory Chapters on the Physiography and Structure of the Arbuckle Mountains, Oklahoma."

Ernest Wilson Sheldon: "Critical Revision of de Haan's Tables of Definite Integrals." 2 vols.

Frank Elbert Wheelock: "On the Nature of the Ionization produced by α-rays."

COLUMBIA UNIVERSITY

Carl Gustave Amend: "On 4- and 5-Acetamino Acetantloranils and Quinazolines derived Therefrom."

Clark Wells Chamberlain: "The Radius of Molecular Attraction."

Ernest Dunbar Clark: "Plant Oxidases."

Leo Joachim Frachtenberg: "Grammar of the Coos Language of Oregon."

Abraham Julius Goldfarb: "Influence of the Nervous System in Regeneration."

Alexander A. Goldenweiser: "Totemism."

William King Gregory: "The Orders of Mammals."

Edward Calvin Kendall: "A Quantitative Study of the Action of Pancreatic Amylase."

Max Withrow Morse: "The Nuclear Components of the Sex Cells of Four Species of Cockroaches."

Henry Alford Ruger: "The Place of Analysis in the Curve of Efficiency."

Elvira Wood: "The Phylogeny of Certain Cerithidæ."

HARVARD UNIVERSITY

Harold Canning Chapin: "A Revision of the Atomic Weight of Neodymium."

Lawrence Wooster Cole: "An Experimental Study of Racoons."

Griffith Conrad Evans: "Volterra's Integral Equation of the Second Kind with Discontinuous Kernel."

Frank Lauren Hitchcock: "Vector Functions of a Point."

Roy Graham Hoskins: "Interrelations of the Organs of Internal Secretion."

William Hammett Hunter: "The Action of Alkali Iodides on Bromanil and the Red and White Silver Salts of some Bromphenols."

Edmund Jacobson: "Inhibition."

Henry Clay McComas, Jr.: "Types of Attention."

Sergius Morgulis: "Studies of Inanition in its Bearing upon the Problems of Growth."

William Albert Willard: "The Cranial Nerves of *Anolis carolinensis*."

UNIVERSITY OF ILLINOIS

Clarence George Derick: "Molecular Rearrangements and the Constitution of Laurolene."

Thomas Reuben Ernest: "Chemistry of Sand-lime Brick."

Alfred Wilhelm Homberger: "Molecular Rearrangements in the Camphor and Fenchone Series."

Paul Edward Howe: "Nitrogen Partition in Repeated Fasting."

John Anton Kostalek: "Nitrogenous Acid Derivatives of Ethyl Malonate."

Henry Albright Mattill: "The Influence of Water-drinking with Meals upon the Digestion and Utilization of Proteins, Fats and Carbohydrates."

Elizabeth Ruth Bennett: "Primitive Groups with a Determination of the Primitive Groups of Degree 20."

Edward Beattie Stephenson: "Magnetic Properties of Heusler Alloys."

Elmer Howard Williams: "The Nature of Spark Discharge at Very Small Distances."

UNIVERSITY OF CALIFORNIA

Charles Bernard Lipman: "Toxic and Antagonistic Salt Effects, and Physiologically Balanced Solutions in their Relations to Ammonification by *Bacillus subtilis*."

Edward Hindle: "A Cytological Study of Artificial Parthenogenesis in *Strongylocentrotus purpuratus*."

Henry Walter Stager: "On Numbers which contain no Factors of the Form $p(kp+1)$."

Edna Earl Watson: "The Genus *Gyrocotyle* and its Significance for Problems of Cestode Structure and Phylogeny."

GEORGE WASHINGTON UNIVERSITY

James Henry Gardner: "The Naciminto and Torrejon Formations of the Puerco Group."

Herbert Harvey Kimball: "Solar Radiation, Atmospheric Absorption and Sky Polarization."

William Thomas Sheperd: "On some Mental Processes of the Rhesus Monkey."

UNIVERSITY OF KANSAS

Fred W. Faragher: "Improved Processes of Laundering."

Arthur Bowes Frizell: "Foundations of Arithmetic."

Robert Spencer Pond: "Collineations in Space of Four Dimensions."

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Charles Horace Clapp: "The Igneous Rocks in Essex County, Massachusetts."

Harold Smith Osborne: "An Investigation of the Potential Stress in Dielectrics."

Richard Chace Tolman: "The Electromotive Force produced in Solutions by Centrifugal Action."

BRYN MAWR COLLEGE

Alice Middleton Boring: "A Study of the Spermatogenesis of Twenty-two Species of the Membracidæ, Jassidæ, Cercopidæ and Fulgoridæ."

Grace Potter Reynolds: "The Reaction between Organic Magnesium Compounds and Unsaturated Compounds containing Alkoxyl Groups."

UNIVERSITY OF IOWA

Albert Kuntz: "The Development of the Sympathetic Nervous System of the Mammalia."

Lee Paul Sieg: "Peculiarities in the Elastic Properties of Certain Wires."

UNIVERSITY OF MISSOURI

Charles Kenworthy Francis: "Phosphorus in Beef Animals."

Louis Lazarus Silverman: "On various Definitions of the Sum of a Divergent Series."

NEW YORK UNIVERSITY

Patrick J. O'Donnell: "The Rôle of Attention and Habit in the Determination of Social Mind and Corporate Life."

John Paul Simmons: "Isomerisms in the Cobalt Ammines."

PRINCETON UNIVERSITY

Howard Hawks Mitchell: "The Subgroups of the Linear Group $LF(3, p^n)$."

Ulysses Grant Mitchell: "Geometry and Collineation Groups of the Plane $PG(2, 2^2)$."

BROWN UNIVERSITY

Henry Carroll Tracy: "The Morphology of the Swimbladder in Teleosts."

UNIVERSITY OF CINCINNATI

Elliott Smith: "Personal Equation and its Variation."

UNIVERSITY OF MICHIGAN

Harvey Lincoln Curtis: "Mica Condensers as Standards of Capacity."

UNIVERSITY OF MINNESOTA

Hal. Downey: "The Lymphatic Tissue of the Kidney of *Polyodon spathula*."

UNIVERSITY OF NEBRASKA

Franklin Davis Barker: "The Trematode Genus *Phisthorcis* Blanchard."

UNIVERSITY OF PITTSBURGH

Robert Horace Baker: "The Spectroscopic Binary, Beta Aurigæ."

STANFORD UNIVERSITY

Solon Shedd: "The Clays and Clay Industry of Washington."

SYRACUSE UNIVERSITY

Floyd Fiske Decker: "On the Order of a Restricted System of Equations."

SCIENTIFIC NOTES AND NEWS

On the occasion of the celebration of the seventieth birthday of Dr. Hermann Wagner, professor of geography at Göttingen, his bust was presented to the Hall of Fame of the university by his students and friends.

Dr. Albrecht Penck, professor of geography at Berlin, has celebrated the twenty-fifth anniversary of his professorship.

Dr. Julius Hann, professor of cosmical physics at Vienna, has retired from the active duties of his chair.

Dr. Oskar von Hertwig, professor of zoology at Munich, has been elected rector of the university for the next academic year.

The Paris Academy of Sciences has awarded the "Fondation Leconte," a prize of 2,500 francs, to Mr. A. R. Hinks, of Cambridge Observatory, for his astronomical researches.

The *Observatory* says that English men of science will rejoice in the election of two more Englishmen—Sir William Ramsay and Sir E. Ray Lankester—into the select body of twelve foreign associates of the Paris Academy of Sciences. There were only eight foreign associates of the academy until December of last year, when the number was increased to twelve. Of the eight associates on the list last year, two were Americans, namely, Newcomb and Agassiz; but it appears that no Americans have been found to fill the places left vacant by their deaths. There is at present one vacancy to be filled, the eleven associ-

ates being: Lister, Suess, Hooker, the Prince of Monaco, Rayleigh, von Baeyer, van der Waals, Dedekind, Hittorf, Ramsay and Lankester.

EDWARD W. BERRY, associate in paleobotany at the Johns Hopkins University, has recently been appointed a geologist on the U. S. Geological Survey and will spend the fall in paleobotanical collecting in the south. Special attention will be devoted to the Tertiary with a view to securing data for correlation. The area covered will extend from Florida to Arkansas.

DR. PEDRO A. DE FIGANIERE, late house-surgeon at the Tuberculosis Hospital, District of Columbia, and Dr. Norman D. Morgan, of San Francisco, have been appointed to positions in the Fur-Seal Service, U. S. Bureau of Fisheries, as resident physicians at the Pribilof Islands, the former on St. George and the latter on St. Paul. They sailed from San Francisco, August 6, on the *Homer* for the Pribilofs.

MR. HARRY JOHN CHRISTOFFERS, class of 1910, University of Wisconsin, has been appointed to a position as scientific assistant in the U. S. Bureau of Fisheries at Washington.

DR. J. E. W. WALLIN, of the New Jersey Training School, has accepted the position of director of the newly-established laboratory of clinical psychology in the New Jersey village for epileptics at Skillman.

MR. R. S. MACKINTOSH, formerly professor of horticulture in the Alabama Polytechnic Institute and state horticulturist of Alabama, is now with the department of horticulture of the Pennsylvania State College in charge of peach investigations. Preliminary surveys are to be made of the several peach growing sections to determine what special lines of experimental work shall be undertaken.

DR. BARTON WARREN EVERMANN, in charge of the scientific work of the U. S. Bureau of Fisheries, has returned to Washington from a tour of inspection of the biological and fish-cultural stations of the Bureau at Fairport, Iowa, Homer, Minn., and La Crosse, Wis. He also gave an address at Terre Haute, Ind., at the celebration of the twenty-fifth anniversary of the presidency of Dr. William Wood Parsons, of the Indiana State Normal School.

MR. H. B. MAUFE, of the Geological Survey of Great Britain, has been appointed director of the Geological Survey of Southern Rhodesia, lately instituted by the Chartered Company.

DURING the past spring Professor Ellsworth Huntington, of Yale University, has been cooperating with the Desert Botanical Laboratory of the Carnegie Institution in a study of American deserts as compared with those of Asia.

FOREIGN journals state that M. Louis Gentil, professor of geology at the Sorbonne, who accompanied the expedition which recently explored the Atlas region under the auspices of the Comité du Maroc, has been entrusted by the French minister of public instruction with a mission to the Muluya Valley, where he will complete his scientific researches in the Algero-Moroccan frontier district.

WE learn from the *Observatory* that the English astronomers who will attend the meeting of the International Union for Cooperation in Solar Research on Mt. Wilson at the end of the present month, are as follows: Professor Schuster, member of the executive committee; Professor Newall, chairman of committee on sun-spot spectra and member of committee on the determination of the solar rotation by means of displacements of lines; Professor Turner, director of computing bureau, member of eclipse committee; Professor Fowler, secretary of committee on sun-spot spectra; Rev. A. L. Cortie, member of committee on sun-spot spectra; Professor Dyson and Major E. H. Hills, members of eclipse committee.

AT the University of Illinois, Professor G. A. Miller gave five lectures on the history of the development of mathematics before the students of the summer session.

NEWS has just been received that Dr. Charles Hugh Shaw, assistant professor of botany in the University of Pennsylvania, was

drowned on July 30, in Kimbasket Lake, British Columbia. Dr. Shaw for a number of years has conducted botanical excursions into unknown regions of the Selkirk and Canadian Rocky Mountains, and this year had attempted in company with half a dozen students and local guides to go around the Big Bend of the Columbia River. Mrs. Shaw was awaiting the party at Revelstoke, B. C.

It is reported that the government of the republic of Ecuador has proposed to present to France the observatory at Quito, together with its apparatus and dependencies, and that the Academy of Sciences has decided provisionally to accept the gift.

In connection with the German Museum at Munich, there will be erected a small observatory with a dome.

The *Electrical World* states that Professor J. A. Fleming, at the University College, and Professor E. Wilson, at King's College, London, have established wireless telegraph stations for communication between these institutions. Instruction is given at each place in the principles and practise of radio-telegraphy.

At a meeting of the trustees of the A. K. Traveling Fellowships, Mr. Sidney Ball, fellow of St. John's College, Oxford, and Professor I. Gollancz, professor of English at King's College, London, were appointed as the first fellows of the English foundation. These fellowships, each of the value of £660, were recently founded by Mr. Albert Kahn, of Paris, to enable the fellows to travel round the world.

The biological station of the U. S. Bureau of Fisheries at Fairport, Iowa, is now sufficiently equipped for carrying on investigations and for actual propagation work in mussel culture. The permanent scientific personnel of the station consists of the following: Dr. Robert E. Coker, director; Mr. H. Walton Clark and Mr. Thaddeus Surber, scientific assistants, and Mr. J. F. Boepple, shell expert.

The *Journal of Geography*, which heretofore has been edited by Professor R. E. Dodge, and published by the Teachers College of New York City, will in the future be edited by Ray Hughes Whitbeck, of the University of Wisconsin, and will be published in Madison.

Professor T. D. A. Cockerell, of the University of Colorado, in Boulder, has recently published as paper No. 1745 in the "Proceedings of the U. S. National Museum" a paper entitled "The North American Bees of the Genus *Nomia*." It appears that in the collections of the National Museum there were a number of undescribed species of the genus *Nomia* to which the late Dr. Ashmead had given manuscript names, but which he had never described. These Professor Cockerell has examined and in the present paper describes for the first time five species, the types of which are in the national collections.

Announcement is made of the forthcoming publication of Dr. Johann David Schoepf's "Reise durch einige der mittlern und südlichen nordamerikanischen vereinigten Staaten, etc., 1783–1784." Erlangen. 1788. 2 volumes. Dr. Schoepf was a surgeon in the German division of the British army, who immediately after the establishment of peace set out from New York and traveled through the coast states as far as St. Augustine. He visited also the Bahama Islands. He was a university man [Erlangen, 1776], interested especially in geology and natural history. His *Travels* give perhaps the best account of this country (from the standpoint of a foreigner), as it was during the Confederation period. There is naturally much geological comment in these volumes, which may be compared with Lyell's, sixty years later. Schoepf gave particular attention to mining operations and examined many mines in New Jersey and Pennsylvania, the two great mining regions of that day. He went as far west as Pittsburgh. The translation is the work of Alfred J. Morrison, editor of the "Travels of Four Years and a Half, in the United States, 1798–1802," by John Davis.

The condition of various crops in the United States on August 1—100 representing for each crop, its average condition on August 1 of recent years (10-year average for most

crops)—was as follows: Peaches, 128.6; winter wheat (yield per acre), 110.5; clover (production compared with average production), 105.5; rye (yield per acre), 101.8; hops, 100.1; peanuts, 99.8; oats, 98.7; sweet potatoes, 98.5; lemons, 98.3; rice, 98.2; tomatoes, 97.5; sugar cane, 97.0; broom corn, 96.7; corn, 96.6; buckwheat, 96.5; onions, 96.1; cabbages, 95.9; beans, 95.8; oranges, 95.6; cantaloupes, 95.2; hay, 95.2; cotton, 95.1; tobacco, 95.0; watermelons, 94.0; sorghum, 93.6; sugar beets, 93.6; hemp, 91.0; alfalfa, 90.1; grapes, 89.5; potatoes, 88.1; apples, 86.3; barley, 82.1; pasture, 81.8; kafir corn, 81.6; millet, 80.3; raspberries, 78.0; blackberries, 76.6; spring wheat, 74.5; flax, 58.5.

IT is stated in *Nature* that at the last meeting of the British Science Guild, held in the rooms of the Royal Geographical Society, communications were received from the Canadian and New South Wales sections of the Guild. In the case of the Canadian section, Lord Grey is resigning the presidentship on account of his departure, and it is hoped that Lord Strathcona will act as president in his place. No fewer than 120 members have joined the New South Wales section of the Guild, and important literature has been forwarded in connection with technical education and the report on open-air spaces for school children in Sidney. The agricultural memorial to the prime minister having received numerous signatures from representative agricultural societies and others was ordered to be submitted to the prime minister. The report of the committee on the synchronization of clocks was finally approved, and it was decided to approach the Local Government Board by deputation and to ask the president to promote legislation on the subject.

THE *Experiment Station Record* states that a secondary school of agriculture for Vermont boys is to be opened next September in connection with Lyndon Institute, Lyndon, Vt. A two-year course in scientific and practical agriculture will be given, designed to prepare young men for successful farming under Vermont conditions. The course will extend over 9 months of each year and will be open to residents of the state eligible for admission to any approved high school. A unique feature of the school is the provision of two methods by which students may pay their expenses, a cash payment system and a work payment system. Boys who choose the latter method will be required to stay at the school throughout the year and will be allowed $25 a month with board and lodging during vacation time and 15 cents an hour for work during the school year. The establishment of the school has been made possible through a gift of Theodore N. Vail, President of the American Telegraph and Telephone Company. The director of the school will be Arthur W. Merrill, a graduate of the New Hampshire College, and for several years teacher of agriculture at the Baron de Hirsch School.

UNIVERSITY AND EDUCATIONAL NEWS

DR. HARRY BURNS HUTCHINS, in accepting the presidency of the University of Michigan, states that he does so on the express condition that he be relieved of the duties of the office at the expiration of five years. Dr. Hutchins graduated from the University of Michigan in 1871, and has been dean of the department of law since 1895.

DR. FRANK LEROND MCVEY will be installed as president of the University of North Dakota on September 29. On that and on the preceding day there will be various academic exercises including the dedication of two new buildings. Addresses are to be given by Dr. Edmund J. James, president of the University of Illinois; Dr. George E. McLean, president of the University of Iowa; the Rev. S. P. Matheson, chancellor of the University of Manitoba, and Dr. A. Ross Hill, president of the University of Missouri.

E. DWIGHT SANDERSON, recently director and entomologist of the New Hampshire Agricultural Experiment Station, has accepted the position of dean of the College of Agriculture, West Virginia University, and will be at Morgantown, W. Va., after September 1.

THE following new appointments for the Kansas State Agricultural College are an-

nounced: Francis H. Slack, M.D. (Tufts), director of the laboratories of the Boston Board of Health, to be professor of bacteriology; J. S. Hughes, A.M. (Ohio), to be assistant in chemistry, and C. H. Clevenger, A.M. (Chicago), and Edward Bartholow, A.B. (Kansas), to be assistants in mathematics.

The *Journal* of the American Medical Association states that considerable dissatisfaction has been manifested in the medical and lay press of Hungary toward the appointment of Dr. L. Nekam to the chair of dermatology in the University of Budapest on the recommendation of Count Fichy, minister of public instruction, whose appointment has been sanctioned by Emperor Francis Joseph. The committee of the medical faculty had proposed the names of Drs. Török and Marschalko, to the general board whose duty it was to investigate and report on the applicants. This body entrusted this duty to a theologian, who ignored the proponents of the medical faculty and appointed Dr. Nekam, with the resulting dissatisfaction.

It is announced that a national office of French universities and schools has been inaugurated under the presidency of M. Paul Deschanel, of the French Academy. Professor Paul Appell, of the University of Paris, and Professor Georges Lyon, of the University of Lille, have been elected vice-presidents and Dr. Raoul Blondel has been appointed director. The new department is to be installed at the Sorbonne, and its object will be to make known to foreigners the educational resources of France.

DISCUSSION AND CORRESPONDENCE

SELECTIVE FERTILIZATION AND THE RELATION OF THE CHROMOSOMES TO SEX-PRODUCTION

Explanations as to what one has really said or meant make dull reading, but are sometimes pardonable in the interest of accuracy. Some one has said (was it W. K. Clifford?) that there are some subjects concerning which it is often difficult to be sure what others mean, and not always easy to be sure what one means oneself! Perhaps selective fertilization and its relation to the "sex-chromosomes" is one of these. At any rate, I find with some surprise that a number of recent writers seem to regard me as an advocate of a conception that I have from the first held to be improbable. The hypothesis of selective fertilization (with all that it implies) may be true, but it is not true that I have anywhere, to my knowledge, maintained or advocated it. On the contrary, already in the second of my "Studies on Chromosomes" this hypothesis was characterized as "*a priori* very improbable" (1905, p. 539), and I have since steadily sought to find an interpretation of the cytological facts that would not involve such a way of cutting the Gordian knot of the sex-problem.

In my third "Study" (1906), where this question was first fully considered, I suggested for purposes of analysis, two possible ways of interpreting the observed facts, but advocated neither owing to insufficiency of data. The first (characterized, rather unluckily, as the "Mendelian interpretation"), assumed, "for the purpose of analysis," that "the two sex-chromosomes, which couple in synapsis and are subsequently disjoined by the reducing division, are respectively a male-determinant and a female-determinant"—*i. e.*, that the two bear opposing or alternative male- and female-determining factors or "genes." Analysis brought out the fact that this assumption led to selective fertilization as a necessary corollary. But even in my first preliminary paper (1905) it was pointed out that this interpretation encountered "great, if not insuperable difficulties." Regarding this, the third "Study" states, "It has not been my intention to advocate the foregoing interpretation, but only to set forth as clearly as possible the assumptions that it involves" (p. 33). Admitting that it "might in fact give the true solution of the problem," I nevertheless "endeavored to seek for a different interpretation that might escape the necessity for assuming selective fertilization" (p. 33). The second interpretation, representing such an attempt, was based on the quantitative re-

lations of the "sex-chromosomes" without assuming alternative male and female genes. It was pointed out that each of the two suggested interpretations included or involved "assumptions which without additional data must be considered as serious difficulties. . . . Additional data will therefore be required, I think, to show in what measure either of the two general interpretations that have been considered may approach the truth" (p. 38). In view of so explicit a statement of my position it is rather astonishing to learn from a recent publication[1] that in my third "Study," because of the difficulties of the second interpretation, I "maintain the alternative view, that the allosomes have qualitative differences that are sex-determining, with Mendelian dominance, and with selective fertilization" (p. 3). It is equally disconcerting to read, further on, that "Boveri, in opposition to Wilson's explanation, does not believe that one chromosome has a male and the other a female tendency, but that they differ only in activity" (p. 5). There is here no indication of the fact that the view opposed by Boveri to mine is also mine, having been put forward as a part of my second interpretation (!).

Not until three years after my third "Study" did I take a more definite position in regard to this question, and then one decidedly against selective fertilization. In the fourth "Study" (1909, sent to press in February, 1908) it was stated only that the first interpretation "should not be rejected without further data, and especially not until the question of selective fertilization has been put to the test of direct experiment" (p. 97). In the fifth "Study" (1909) this question is not taken up. Finally, in two general reviews of the whole subject in its broader bearings[2] selective fertilization is treated as so improbable as almost to invalidate any interpretation into which it enters. I am therefore again somewhat at a loss to comprehend how another recent writer can say that after framing several theories of sex I have at length adopted as my "latest view" one that "not only assumes a great complication of gametic representatives, but also involves selective fertilization."[3]

I am very willing to take whatever may be my just share of blame for such misunderstanding—even though I think it might have been avoided by a little more care in reading. It may be due partly to the fact that I did not at first see that my second (quantitative) interpretation was no less Mendelian than the first, as Castle has since pointed out. Beyond this, a certain ambiguity may have been caused by too great brevity in certain passages of the fourth and fifth "Studies," where the question of qualitative differences of the "sex-chromosomes" is touched upon. These brief references took for granted the context supplied by the full critical discussion given in the third "Study," and the ambiguity disappears, I think, when this is borne in mind. One instance may be given from the fifth "Study," which contains the statement, "I believe that if the idiochromosomes be the sex-determinants their difference is probably a qualitative one" (p. 189). In this passage the careless omission of the words "in the male" after "difference" obscures the meaning and might readily mislead a reader who had not the full context in mind. No ambiguity will be found, I hope, in the two reviews already cited, where the general conclusions from my own and other investigations in this field are brought together.

Lastly, I have not committed myself to the view that the "sex-chromosomes" represent the exclusive factors of sex-determination, though in several places they have been provisionally assumed to be such in order to discover the consequences of such a view. Other possibilities are pointed out in several of my papers on the subject, and I have gone no farther than to maintain the probability that these chromosomes are "one of the essential factors." This question, like that of selective fertilization, seems to me an open one; and until both questions have received a certain

[1] Montgomery, *Biol. Bull.*, XIX., 1, 1910.

[2] SCIENCE, February, 1909; *Science Progress*, April, 1910.

[3] Geoffrey Smith, *Q. J. M. S.*, February, 1910.

answer, the meaning of the cytological facts will not become entirely clear.

Edmund B. Wilson

Woods Hole, Mass.,
August 5, 1910

HIGHER EDUCATION IN PITTSBURGH: A COMPARATIVE STUDY OF SALARIES

In the numerous articles on the question of college and university salaries that have recently appeared there seems to be a perfect unanimity of opinion that, considering the high services rendered, the salaries of teachers are altogether too small. The conviction seems quite general that teachers are less adequately paid than any other class of workers. The figures published in the bulletins and reports of the Carnegie Foundation for the Advancement of Teaching have further deepened and enforced this conviction.

In these reports two classes of figures have been given, the average and the maximum salaries of professors and other teachers. But the minimum salaries of teachers and the salaries of presidents have not been given. Had these been included in the reports it is quite likely that the conception would have been still further deepened that teachers are poorly paid. In some institutions the minimum salaries are distressingly low, and afford the best basis for reckoning the actual conditions. After an experience of some years in the University of Pittsburgh I have been interested in a comparison of salaries which I herewith present as possibly of general interest.

I have not been able to obtain figures for all the institutions I wished to include in the comparison, as the view seems to prevail that the business of universities, other than state institutions, is the private affair of the trustees and need not be given to the public. The figures I give have been taken from official reports and from Carnegie Foundation publications, or have been received directly from officers of the various institutions. In all cases the figures used are the salaries of full professors, and for the academic year 1908–09 only, except where comparison is directly made with other years. No doubt in some cases the figures for the past year, 1909–10, would differ from these, but they are not yet available.

A curious fact about Pittsburgh is that the high school pays uniformly better salaries than the university, except in the single case of the heads of the institutions. In the high schools of the city, the minimum for professors is $2,000, in the university $1,200; while the maximum in the high schools is $2,500, and in the university $1,800. Similarly, the high-school principals receive $3,000, and the university deans $2,000. On the other hand, the director of high schools receives $4,000, while the chancellor of the university receives $7,500. Thus it appears that high-school teaching pays much better than university teaching, but high-school administration pays only a little better than half as well. Every year it happens, therefore, that students in going from the high school to the university pass up to teachers receiving much less than their preparatory teachers, but come under a chancellor who receives almost twice as much as their high-school director. It may be said in passing that the high school has a regular schedule of salaries, whereas none exists for the university, each teacher being engaged on an individual salary.

It should be said in fairness that the foregoing figures for the University of Pittsburgh are in some respects different from those of previous years. For some time preceding the academic year of 1908–9, one salary of $2,500 had been paid. But for that year, that and another of $1,800 were dispensed with, and in their places two of $1,500 and $800 were given, the latter to an instructor. A saving of $2,000 was thus made for the university; but as the chancellor for the same year received an increase from $6,000 to $7,500, the net saving to the university was only $500.

An interesting set of facts can be obtained by a comparison of the average salaries of professors of the University of Pittsburgh for several successive years. The second annual report of the president and treasurer of the Carnegie Foundation for the Advancement of Teaching, published October, 1907 (p. 24),

gives the average professorial salary in the Western University of Pennsylvania (now the University of Pittsburgh) as $1,864. The third annual report of the same institution, published October, 1908 (p. 44), gives the average as $1,718. The figures I have obtained for the academic year 1908–9 show the average as $1,609 for full professors in the college and school of engineering, not including the heads of the two or three departments who had only the rank of instructor. These figures show that the university in three years by careful management was able to reduce the average expenditure for professors' salaries by $250.

On the other hand, the salary of the chancellor has undergone a steady and rapid increase. Up to 1900 the regular salary was $2,500. In 1901 it was increased to $5,000. In 1904 the present chancellor assumed office at that salary. The following year the amount was increased to $6,000. After 1907 the salary schedule no longer appears in the financial report, but I have learned that in 1908–9 the chancellor received $7,500. Thus it appears that while the salaries for instruction have been gradually but surely decreasing for some time, that for administration has been rapidly increasing. The salaries for instruction and administration seem to vary in inverse proportion.

In this institution, the University of Manitoba, as I find, salaries are on a very different scale. All professors receive exactly the same salary, $2,500, and assistants are likewise on a regular schedule. Up to the present time there has been absolute equality in professorial salaries, and for the future the minimum, at any rate, is certain to be no less. On account of the system of denominational colleges that until a few years ago constituted the teaching bodies of the university, there has been no president. But now that the university itself has a large staff of teachers a president is to be appointed. Within the past month the committee has fixed the salary at $6,000.

Similar proportions are shown by the figures for some other universities that are neighbors to the University of Pittsburgh. For instance, in West Virginia University the minimum professorial salary is $2,200, having been recently increased from $2,000. The vice-president receives $2,600, and the president $4,200 and residence, or a total of about $5,200. The average salary of professors is given in Carnegie Report No. 2 as $2,025 (evidently made up before the increase).

Summing up, we have the following table:

	Salaries of Professors		Dean or Principal	Average	Salary of President or Head
	Minimum	Maximum			
Pittsburgh high school	$2,000	$2,500	$3,000		$4,000
University of Pittsburgh	1,200	1,800	2,000	$1,609	7,500
University of Manitoba	2,500	2,500	2,500	2,500	(6,000)
University of West Virginia	2,200	2,500	2,600	(2,025)	5,200(?)

Were the salary of the chancellor of the University of Pittsburgh arranged on the same scale as in the other two universities, it would be a very different amount. Comparing only with West Virginia University, where there is a similar range of figures in all the columns, if made to bear the same relation to the minimum, it would be approximately $2,800, and if based on the maximum it would be $4,000, instead of the $7,500 it actually was. Apparently, in the University of Pittsburgh, no attempt is made to keep the salaries of professors at any established proportion of that paid to officers of administration. Who is responsible for the anomalous condition it is difficult to tell.

It clearly ought not to be possible in any institution of learning for the head to profit by the decrease of the salaries of teachers, nor for the head of a university to obtain between four and five times the average of that of the full professors. The salaries of teachers ought not to be subject to exploitation by the head, but teachers should receive in all institutions (whether state or not should make no difference) a fair share of the proceeds of the

institution. Professor Cattell recently said in an address at Harvard that "The first step of a really great president would be to refuse to accept a larger salary than is paid to the professors."[1] In the University of Pittsburgh, however, there is an increasing difference between the salaries for teaching and for administration.

There seems to be a diversity of opinion on the matter of presidents' salaries. In Bulletin No. 2 of the Carnegie Foundation, May, 1908, it is stated that "the salaries [of presidents] are not much above the upper range of what a professor may receive" (p. 25). From the figures just given it will be seen that this statement holds approximately true for the two state universities referred to, but is very wide of the mark for the University of Pittsburgh. And there is every reason to believe that many more small colleges and universities show a similar disproportion. In view of these and other considerations, it seems to me that the Carnegie Foundation should make a complete and thorough investigation of the matter, especially of those institutions now on the accepted list. The foundation has already done great service by publishing the average and the maximum salaries for professors in many institutions, but this has been as much in the interests of institutions as of the faculties. A very great service could be rendered to the professors themselves by publishing also the minimum professor's salary and the president's salary. Inasmuch as the prime purpose of the foundation is to advance the profession of teaching, and not institutions as such, a thorough investigation should be made, and at the earliest possible moment.

A. W. Crawford
University of Manitoba,
June 30, 1910

On the Origin of Flint-like Slate near Chapel Hill, N. C.

To the Editor of Science: In a recent bulletin of the North Carolina Geological and Economic Survey Dr. F. B. Laney[1] has occasion to refer to an article by me[2] on the flint-like slate near Chapel Hill, and concludes from the partial chemical analysis and petrographic description there given that I am unwarranted in ascribing to the rock a sedimentary origin. In the quotations from my article no reference is made to the field data upon which the classification of the rock as a sediment was based.

The rock in question lies in distinct beds in a sedimentary series which includes sandstones and conglomerates, and in places it grades off into a fine sandstone. It coincides in dip with the other members of the series and can be traced for miles along the strike, and does not pinch out as would be the case with a lava flow. At several localities along Morgan's Creek, the one nearest Chapel Hill being at King's Mill, two miles distant, the slate lies unconformably upon sheared felsite or rhyolite, the marked difference between the two rocks being apparent at a glance.

The partial chemical analysis of the rock was given to show specifically its close resemblance to the local sheared felsites from which it was supposedly derived by mechanical wear. Dr. Laney does not seem to realize that the material of a felsite or rhyolite, broken down and reconsolidated, may show the same essential characteristics as the original rock. It is evident that he has not seen the flint-like slate in place in this neighborhood.

H. N. Eaton
University of North Carolina

The Oscillations of Swinging Bodies

To the Editor of Science: May I be allowed to say that farther investigation shows that the forms of two of the curves in a

[1] "The Case of Harvard College," *Popular Science Monthly*, p. 613, Vol. LXXVI., No. 6, June, 1910.

[1] North Carolina Geological and Economic Survey, Bull. 21, 1910, "The Gold Hill Mining District of North Carolina," by F. B. Laney, p. 18.

[2] Elisha Mitchell Scientific Society, *Journal*, Vol. 24, No. 1, April, 1908, "Micro-structure and Probable Origin of Flint-like Slate near Chapel Hill, North Carolina," by H. N. Eaton.

paper on the "Damping of the Oscillations of Swinging Bodies by the Resistance of the Air" which I published last year, must have been somewhat affected by a minute spark which escaped my notice, but which lasted for perhaps the thousandth part of a second and thus effectually prevented the break in the circuit of the deflecting current from being abrupt? The very interesting discontinuities in the motion of bodies swinging under certain laws of damping are not very appreciable in the air at the small velocities described in the paper mentioned.

HARVARD UNIVERSITY B. O. PEIRCE

SCIENTIFIC BOOKS

Birds of New York. By ELON HOWARD EATON. Memoir 12, New York State Museum, John M. Clarke, Director. Part I. Introductory Chapters; Water Birds and Game Birds. Albany, University of the State of New York. 1910. 4to, pp. 501 (+160 pp. of unpaged tabular matter between pp. 86 and 87), 42 colored plates, and many half-tone illustrations in the text.

Of the many manuals and reports on birds issued under the authority of the various state governments none approaches in voluminous detail and fullness of illustration the present work (which will form two thick volumes in quarto) on the "Birds of New York," of which Part I., comprising the introductory matter and the water birds and game birds, has recently appeared. The author, Elon Howard Eaton, has shown himself well fitted for the task, both the introductory matter and the systematic part giving evidence of thorough research and good judgment. The present work is therefore a worthy successor to the illustrated quarto volume on birds by Dr. J. E. DeKay, published in 1844 as Part II. of the "Natural History of New York"—a work of great usefulness for many years, beyond as well as within the boundaries of the state.

The first part of the present work opens with a "Summary of the New York State Avifauna," in which the 411 species that have been recorded as occurring in the state are classified in six categories, in accordance with their manner of occurrence, as residents, summer residents, transients, winter visitants, summer visitants and accidental visitants. This is followed by a consideration of the life zones of the state, namely, the Canadian, Alleghanian and Carolinian, illustrated by a map shaded to indicate relative elevation, with cross-hatching in red and blue to demark the life zones; but unfortunately many of the place names are practically illegible, even with the aid of a hand-glass. Other smaller maps of similar character illustrate the breeding ranges of twenty-two species, while several pages of charts graphically indicate the breeding ranges of all the species that breed in the state with reference to their representation in the different life zones. Consideration of the Mount Marcy region, of the increase and decrease of species and the cause, a few pages of appropriate "suggestions to bird students," and such other topics as "bird migration," "spring arrivals," "county schedules" and "classification," make up the rest of the 90 pages of introduction. Under "spring arrivals" the dates of arrival of 90 species at 30 localities are given for a series of years in three tabular inserts, and two maps show the dates of spring arrival of the Baltimore oriole and barn swallow for the year 1905 at different points throughout the state. Under "county schedules" an attempt is made "to show in condensed form the status of our knowledge concerning the birds of each county in New York State." This laborious compilation is tabulated in 75 inserts placed between pages 86 and 87.

The systematic part (pp. 91–390) follows the classification and nomenclature of the American Ornithologists' Union Check-List of North American Birds, and includes the species from the grebes to the end of the pigeons. Diagnoses are given of the family and higher groups, with some additional comment, as well as of the species. The matter relating to the latter is classified under the subheadings "description," "field marks," "distribution," "migration," "haunts and habits," "food," "nests and eggs," etc., and varies in

amount with different species, including in many instances very full biographies. The references are restricted to the citation of the place of original description of the species, of DeKay's work, and the second edition of the A. O. U. Check-List. As the later supplements to the Check-List are not cited, in cases where the nomenclature of the second edition has since been changed, the names adopted would seem to be not those of the Check-List but of the author's own selection. After the names a glossary is added, giving the derivation and accent of the technical names, a feature too rarely found in works of this character. The eccentric use, or non-use, of capital initials in the English bird names and in many geographical names is doubtless not the preference of the author.

A notable feature of the work is the illustrations, which comprise 42 colored plates, illustrating 132 species, from drawings by Louis Agassiz Fuertes, and a large number of half-tones in the text. Fuertes is here seen at his best. The grouping in some of the plates is excellent; in others too many figures are crowded upon a single plate, an exigency for which he is doubtless not to be held responsible. Again, the backgrounds in some cases detract from the general artistic effect, and might often have been omitted as a needless and inharmonious element of the picture. The color printing obviously does injustice to the drawings, the dull reds presenting a monotonous sameness not warranted by the tints given the birds by nature. Yet with these drawbacks the plates are effective aids in recognizing the species depicted. The poses and attitudes are in most cases admirable and the structural details scientifically correct. For the artist is not only an exceptionally gifted draughtsman, but an ornithologist as well, and a trained and keen observer.

The text illustrations are numerous and appropriate, varying from details of structure to full-length figures, some of them from nature, as in the case of young birds, nests and haunts, and others from some of Audubon's plates or from mounted birds, usually New York state specimens of rare species, as in the case of the scaled petrel, white swan, man-'f-war-bird, white-faced glossy ibis and others.

The work is well-printed, from large, clear type, with few typographical errors[1] (on p. 22 and in the index for Linnett read Sennett!), but is ponderous to handle, the half-tones in the text necessitating the use of heavily coated paper, thus insuring rapid deterioration for a book worthy of long life. From the point of view of good book-making the work is sadly defective, there being, for example, no list of the plates or of the text illustrations, and no clue to what species or how many are figured without looking through the text and the plates. The eighty-odd sheets of inserts are bound in so deep that the middle columns are difficult to get at to read, and are neither paged nor consecutively numbered, but are arranged in "sections" numbered 1 to 4 with 15 to 20 "parts" in each, with the legend half concealed by the method of binding. The regular pagination of the text runs to page 390, with then a gap to page 474, on which the index begins, the gap being filled by the plates, each with an explanatory, unpaged leaf, evidently counted as two pages.

From the letter of Director John M. Clarke to Commissioner Andrew S. Draper (see p. 3), the purpose of the present work is "to bring together the increments to knowledge [of New York birds] during the long period which has elapsed [since 1844] without active interest therein on the part of the State." To say that it faithfully fulfills this purpose is but just credit to both author and artist.

J. A. Allen
American Museum of Natural History,
New York City

Mineralogie de la France et de ses Colonies. Tome Troisième, 2e partie. A. Lacroix. Librarie Polytechnique, Ch. Béranger, Editeur, Rue des Saints-Pères, 15, Paris. 1909.

No less welcome than the appearance of the

[1] There is a curious slip on p. 76, in citing a paper by George N. Lawrence, published in 1866, under a wrong title and ascribing its publication to a society that did not come into existence till 1878!

second part of the third volume of Lacroix's well-known "Mineralogie de la France," is the announcement that the fourth and last volume is now in press. This monumental description of French minerals, the first part of which appeared in 1893, will therefore soon be complete. The present part, printed eight years after the first part of volume 3, deals largely with the carbonates, of which calcite naturally takes the largest share. Starting in with the description of the French occurrences of brucite and hydrocuprite, the nitrates are taken up (10 pages), to be followed by the carbonates. These make up the bulk of the part before us, and the volume is concluded with an appendix to the carbonates (whewellite and mellite), an appendix of twelve pages and the index to volume 3. The description of calcite extends over about 170 pages and is illustrated by 267 crystal drawings and photographs. Then follow descriptions, replete with crystal drawings, of the other rhombohedral carbonates; giobertite (magnesite), mesitite and pistomesite, siderite, dialogite (rhodocrosite), smithsonite, dolomite and ankerite. The descriptions of these rhombohedral carbonates cover nearly 250 pages, or over half the book. Of the orthorhombic carbonates the description of aragonite is very full and richly illustrated. Then follows witherite, strontianite and cerussite. A detailed description of ctypéite is given and it is evident that Lacroix still holds ctypéite as a third modification of $CaCOo_3$, distinct from calcite and aragonite, basing his determination on the optical properties. Hydrozincite, aurichalcite, malachite, dawsonite and bismuthite follow. The description of chessylite (azurite) is naturally very full, there being 56 illustrations of chessylite from the classic locality at Chessy. Descriptions of phosgenite, thermonatrite, natron, trona, nesquéhonite and hydromagnesite close the volume. In the appendix may specially be noted the descriptions of barytocalcite, bernonite of Adam (Tableau minér., 1869) identified as a variety of evansite, calcite (additional description), cristobalite and leesbergite (optically homogeneous). A page of errata to the first part of volume 3 is given.

WALDEMAR T. SCHALLER

Yorkshire Type Ammonites. Edited by S. S. BUCKMAN. Pt. I., pp. i–xii, *i–ii,* plates i–xi, and descriptions 1–8. London, William Wesley & Son. 1909. Price 3s. 3d. each part.

The Jurassic ammonites of Yorkshire to the number of about 150 species were long ago described by Young and Bird and by Martin Simpson in a number of publications issued from 1822 to 1855, with a second edition of one of Simpson's works as late as 1884. Young and Bird's descriptions were inadequate and only a part of them were accompanied by poor figures. Simpson's species were published without illustrations. Fortunately nearly all of the type specimens have been preserved and Mr. Buckman is doing paleontology a real service in the present work by publishing faithful reproductions of excellent photographs (by J. W. Tutcher) of the types. The original descriptions are reprinted and are supplemented by descriptive notes and comments by the editor, who also assigns the species to the numerous genera and families that are now recognized and contributes discussions of the genera represented.

The work will be issued in about sixteen parts, each of which will contain about twelve to sixteen plates. The published first part gives figures of eleven species belonging to the genera *Amaltheus, Uptonia, Platypleuroceras, Harpoceras, Agassiceras, Oxynoticeras, Harpoceratoides* and *Pseudolioceras.* It is evident that the work when completed will be indispensable to paleontologists who have to deal with Jurassic and especially Liassic ammonites.

T. W. STANTON

SPECIAL ARTICLES

ON THE INCREASED PERMEABILITY OF SEA URCHIN EGGS FOLLOWING FERTILIZATION

IN SCIENCE for July 22, 1910, McClendon has shown that the permeability of the egg to ions is greater after fertilization. He used an electrolytic method. We wish to set forth observations made during this summer, which indicate that the increased permeability is not confined to ions alone, and that it is more or less specific for various substances.

1. Certain intravitam stains were taken more quickly and in larger amounts by fertilized eggs than by unfertilized. *Toxopneustes* eggs, both fertilized and unfertilized, were placed in a weak solution of methylene blue for three to ten minutes. The former were always more deeply stained. The difference was striking. That this was not due to the greater oxidative activity of the fertilized eggs was shown by staining unfertilized eggs and then fertilizing part of them. These stained eggs developed normally to swimming larvæ and preserved nearly the same color as the unfertilized eggs of the same lot and treatment. Unless very deeply stained before fertilization they never approached the degree of color of eggs fertilized before being stained, both lots having been exposed to the dye for the same length of time.

It was observed that, while the mature unfertilized eggs stain faintly, immature eggs with large germinal vesicles stain even more deeply than fertilized eggs. It seems that the process of maturation leads to lessened permeability to certain substances, and it may be that fertilization restores the permeable character necessary for the exchanges lying at the basis of cell division.

The eggs behave toward the stain dahlia as toward methylene blue. Bismarck brown and neutral red, however, stain unfertilized *Toxopneustes* eggs the same as fertilized.

2. Eggs treated with hypertonic salt solution to induce parthenogenetic development, returned to sea water and then stained with methylene blue were more deeply colored than the untreated control. Great variations in stainability were found in the same lot of eggs treated as above. Those eggs which took the deepest stain were found to be the ones which divided soonest and developed best. Treatment of unfertilized eggs with weak acetic acid followed by return to sea water to induce artificial membrane formation was found also to increase the permeability of the eggs to methylene blue.

3. If fertilized and unfertilized eggs stained equally with methylene blue were placed in an Engelmann chamber and a current of hydrogen passed over them, the unfertilized became pale sooner than the fertilized. This may have been due to the less oxidizing (greater reducing) power of the former.

If after both sorts of eggs became colorless in the hydrogen, air was readmitted to the chamber, no difference could be detected in the time required by the two sorts of eggs to become blue again. We are inclined to interpret this as indicating that fertilized and unfertilized eggs are equally permeable to oxygen.

4. If a large mass of *Arbacia* eggs was fertilized in a small volume of sea water and allowed to settle, the water was always found to be slightly colored with the egg pigment. This was never observed in similar suspensions of unfertilized eggs treated in the same way except as to the addition of sperm. Some or all of the eggs on fertilization must lose pigment. Microscopic examination showed some fertilized eggs less deeply pigmented than others. This loss of pigment in fertilized eggs seems to be due to their greater permeability to their own coloring matter.

5. One[1] of us showed last year that following fertilization there was an increase in the ability of the egg to catalyze hydrogen peroxide. It was suggested that this might be due to an increase in permeability, and some experiments were detailed confirmatory to this view. The experiments tried this summer have shown that any treatment which increased the catalase action of the unfertilized egg also increased its stainability by methylene blue. We therefore believe that the greater catalytic activity of fertilized eggs is an expression of their greater permeability.

6. If weak iodine solution was added to equal amounts of fertilized and unfertilized eggs in separate dishes and starch was added a few moments later, it was found that the iodine had disappeared entirely from the sea water surrounding the unfertilized eggs, while the water surrounding the fertilized eggs still gave abundant evidence of the presence of iodine. The difference was very striking.

[1] Lyon, *Amer. Jour. of Physiol.*, XXV., p. 199, 1909.

We have not studied the matter sufficiently to hazard an explanation. The simplest working hypothesis would be that the difference observed is an expression of the greater reducing activity of the unfertilized eggs. It may be imagined, however, that the iodine is disposed of in the unfertilized eggs by the lipoids of the plasma membrane. In the fertilized eggs these lipoids may be redistributed or otherwise changed in the membrane, and this change in the lipoids may lead to the increase in permeability to certain substances. This supposition would tend to bring our iodine experiments into relation with the other observations on permeability.

E. P. LYON
L. F. SHACKELL

FISHERIES LABORATORY,
BEAUFORT, N. C.,
July 26, 1910

A PECULIAR HEAT PHENOMENON

THE phenomenon described here was discovered unexpectedly in connection with a lecture experiment on vapor pressure. An inverted barometer tube *A* is arranged so that the space above the mercury is filled with water and water vapor. A glass tube *B* surrounds the barometer and allows steam to enter at the top, surround the barometer, and pass out at the bottom. As the vapor is warmed by the steam, it increases in pressure and pushes the mercury down.

The incoming steam does not pass immediately through the tube, but works its way gradually downward, its progress being noted by the condensation on *B*. The mercury column follows the condensed steam line regularly until it is depressed about 12 cm., when it begins to oscillate. Thus, if *B* represents the lower end of the condensed steam, the oscillations take place symmetrically on either side of *B* between *E* and *F*, the distance *EF* being from 2 to 4 cm. In the meantime, the steam line progresses steadily downward; the oscillations following it closely and becoming more rapid and of less amplitude until they finally cease near the bottom of the tube.

The action is a close approach to that of a Carnot's engine. The substance goes through a complete cycle during each oscillation, absorbing heat at steam temperature and giving it out to the cold tube below *B*. It becomes cooled also by the work it does in expanding. It is then pushed back up the tube from below,

FIG. 1

its pressure being less than when expanding because its temperature is less. Therefore more work is done during expansion than contraction. The indicator diagram is probably of the form shown in Fig. 2.

The oscillations of the mercury column would tend to stop when the tube below *B* be-

comes warmed to steam temperature; but as the mercury is being pushed steadily downward where the tube is still cold, the oscillations continue. Inasmuch as the center of gravity

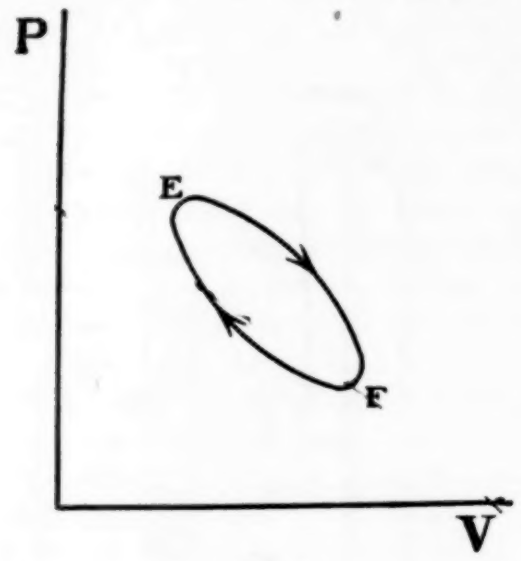

Fig. 2

of the mercury is not permanently changed during one oscillation, the only work done is that against friction. Energy must be supplied to maintain this motion.

The explanation given here is the one advanced by Griffiths[1] to explain a similar phenomenon where a bulb of air was connected to one end of a U-tube partly filled with mercury. On heating the bulb with a gas flame the mercury oscillated. Griffiths pointed out that it would be useless to compare the quantities of heat received and rejected, because the expansive substance is constantly in contact with conducting bodies at different temperatures. He stated also that the action of hot-air engines is of the same nature as the one described; a prediction that was verified by Webster[2] who, by means of an ingenious device on a small hot-air engine, projected its indicator diagram on a screen in a lecture room. The diagram was of the form shown in Fig. 2.

F. R. Watson

University of Illinois,
May 19, 1910

[1] E. H. Griffiths, "The Thermal Measurement of Energy," pp. 49–52, Cambridge Press, 1901.

[2] A. G. Webster, "A Hot Air Engine Indicator Diagram," *Phys. Rev.*, 30, 264, No. 38.

MICROSEISMS

Ever since sensitive earthquake instruments have been built, it has been found that outside of earthquakes, which show characteristics in their records peculiar to themselves, there are other disturbances recorded; disturbances that manifest themselves by their continuity, extending over hours, days and even weeks. They appear as small pulsations, the undisturbed trace of the seismogram being converted to a finely serrated line. The amplitudes may gradually increase to a millimeter or even more on our instrument, and then disappear again. In general they are far more prevalent during the winter season than in the summer. These pulsations or tremors I call microseisms. The question naturally arises, what produces these vibrations? Are they due to a constant stress in the earth's crust which at times adjusts itself by a rupture along some weak line, along a fault, or are they produced by thermometric or barometric conditions of the atmosphere. Among phenomena of the latter we may consider winds, and the position and movements of the area of low barometer.

A very superficial examination of the facts eliminates the temperature effect, that is, the varying heat from day to day.

For the barometric conditions of the atmosphere there was available at the observatory the record of the Shaw microbarograph and also the Canadian daily weather maps. The microbarograph has a magnification of 20, so that rapid fluctuations in pressure are very well shown, as shown by local strong winds. The daily weather maps show the position of the isobars from the Pacific to Newfoundland in the Atlantic, with differences of pressure of 0.1 inch for adjoining isobars.

The seismograms are the records of two Bosch photographic horizontal pendulums mounted N.–S., E.–W., respectively, on a concrete pier free from the cement floor in the basement of the observatory. The theoretical magnification of the record is 120 and the pendulums have air-damping. The periods of the pendulum are adjustable and lie generally between 6 and 10 seconds. The time-scale on

the seismogram is represented by 15 mm. to the minute, so that individual seconds are easily read. The daily sheets are therefore about a yard long and seven inches wide.

For the past two years the writer has made daily comparisons between the seismograms, barograms and weather maps to find what connection, if any, existed between the different phenomena. That on the seismogram we had to deal with earth-movement and not with oscillations of the pendulum becomes obvious to any one examining the record. Undoubtedly the pendulum may be set in vibration by an impulse, but the former would soon die down on account of the damping, which however is not the case, but instead the pulsations are kept up at times for hours and days. When the period of pulsation is nearly that of the period of the pendulum we find a crescendo and diminuendo showing a spindle shape in the record, and the repetitions of figure take place when the pulsations have gained or lost one on the number of vibrations of the pendulum.

As already intimated an earthquake record, with its various phases of longitudinal, transverse and surface waves, can never be confounded with microseisms.

Let us first compare the microbarograms with the seismograms, taking of the former one that shows rapid fluctuations of pressure, being accompanied by more or less gusty strong winds. On the seismogram will be found simultaneously disturbances, well-marked, but their character is totally different from the microseisms under consideration. Instead of being of the regular form, more or less like saw-teeth, spoken of, they are irregular, a sort of "drunken" record, involving probably undulatory movement beside some pulsations and vibrations. This record differentiates itself very clearly from that of earthquakes and microseisms.

Next we compare the weather map with its isobars and areas of high and low barometer. We are soon led to the belief that we are dealing in broad outlines at least with two records of the same phenomenon. When in summer the isobars run almost across the continent, areas of low and high barometer are ill-defined, and the gradients, or lines at right angles to the isobars, are long, it will be found that the seismograph is almost or wholly quiescent. However, with the advent of autumn the isobars begin to move more closely together, areas of low become confined figures which move regularly across the continent, then the microseisms make their appearance, and seem to some extent to be a counterpart of the atmospheric conditions. We appear now to be on the right track. But a nearer relationship is yet to be found. Of one thing we are certain so far, and that is, that if the isobars stretch far over the continent with few and long gradients then there will be no microseisms. The converse, however, as experience has shown, can not be so definitely stated, viz., that when isobars are close together, surrounding a low with steep gradients that then strong microseisms will be recorded. Some microseisms will be shown undoubtedly, but not necessarily as a measure of the gradients about a low anywhere. Examination from day to day revealed the important fact that the position of the low is a very material factor in the production of microseisms. For instance, we have a low approaching over land from the western quadrant, as they always do, showing on the face of it a strong cyclonic movement, yet our seismograph does not seem to be affected by it as long as it is to the west of Ottawa. However, after it has passed Ottawa and descended the St. Lawrence valley or passed along the Atlantic coast to the Gulf of St. Lawrence and over Newfoundland to the Atlantic, then the microseisms become very active and we obtain a sheet of serrated lines with amplitudes indicative more or less of the steepness of the gradient. The important discovery that we have made is that the area of low with steep gradients to be most effective in producing microseisms must be over water, *i. e.*, the ocean.

So far our facts seem to be well correlated, but there is one essential link still missing, viz., "How does the area of low barometer with steep gradients resting on the water produce the microseisms?" To this question

I am not as yet prepared to give an answer. As intimated in my report of the International Seismological Association, a special committee has been appointed to investigate this particular point.

We may sum up then the conclusions so far arrived at:

1. Microseisms are essentially due to meteorological phenomena, that is, to barometric pressure and the accompanying gradients.

2. The amplitude of microseisms is largely a function of the steepness of the barometric gradient.

3. Areas of low barometer with steep gradients, but west of Ottawa have little effect in producing microseisms.

4. Strong microseisms are almost invariably accompanied by steep gradients in the Gulf of St. Lawrence, with the St. Lawrence valley, containing the Great Champlain Fault, on a line of steep gradients.

5. A well-marked low sweeping up the Atlantic coast from Florida to Newfoundland is almost always accompanied by marked microseisms.

6. Microseisms are but slightly, if at all, influenced by the movements of lows across the continent.

7. Microseisms are not produced by local winds, frictional excitation of the earth's surface.

8. Microseisms represent vibrations in vast blocks of the earth's crust, covering tens of thousands of square miles; and the period is possibly dependent on or modified by marked geological configuration and depth.

9. Microseisms once produced may continue for some time when the immediate cause has passed.

To the above may be added that, as the microseisms are mainly dependent on the action of the low on the ocean, and as at Ottawa they are recorded *after* the low passes, the reverse should be the case in Europe, where the ocean is to the west, and the low passes over it *before* reaching the continent.

Otto Klotz

SOCIETIES AND ACADEMIES

THE IOWA ACADEMY OF SCIENCE

The sessions of the Iowa Academy of Science were held in the zoological lecture room in Blair Hall, Iowa College, Grinnell, beginning at 1:30 P.M., Friday, April 29.

The public address by Professor William A. Noyes, of the University of Illinois, on "A Scientific Revolution," was given Friday at 8:00 P.M., in the college chapel.

The Digestibility of Bleached Flour: E. W. Rockwood.

The Effect of Continued Grinding on Water of Crystallization: Nicholas Knight.

A Study in the Determination of Calcium: George W. Heise.

A Notice on the Cast Iron Casing in Well Four at Grinnell: W. S. Hendrixson.

The Iowa Lakeside Laboratory (illustrated): R. B. Wylie.

A brief account of the first session of this biological laboratory, summer, 1909, with lantern slide illustrations of the grounds, buildings and points of interest near the station.

The Flower of Elodea (illustrated): R. B. Wylie.

Details of an undescribed type of staminate flower, which at maturity elongates similarly to the pistillate flower of this genus.

Preliminary List of the Parasitic Fungi of Fayette County, Iowa: Guy West Wilson.

The results of field work in this region since the autumn of 1907 are embodied in this paper. While the number of species found is quite large, and many of them of no small interest, further field work will greatly augment the list. This is especially true of the Jung Imperfecti, which have been least thoroughly studied.

Prairie Openings in the Forest: B. Shimek.

A discussion of the prairie flora of these openings; and of the conditions which cause its appearance.

The Influence of Air-currents on Transpiration: Miss Maud A. Brown.

An account of the results of laboratory experiments showing the effect which currents of air of various velocities have on transpiration.

Delayed Germination: L. H. Pammel and Charlotte M. King.

For some years we have made a study of the germination of weed seeds under different condi-

tions. The work was started in 1901 and subsequently carried out for one year by Mr. H. S. Fawcett. It was found that in many cases seed did not germinate readily in the fall, but after a period of stratification and freezing germination proceeded more readily. One of the remarkable features in this study was the great irregularity with reference to the germination of seeds. The paper cites some of the important literature on the subject with reference to delayed germination.

The Problem of Weeds in the West: L. H. PAMMEL.

A brief account of weedy plants observed in Manitoba, Saskatchewan, Alberta, British Columbia, Washington, Oregon and the region between the Rockies and the Missouri River compared with the weeds of Iowa.

Spore Formation in Lycogala exiguum: HENRY S. CONARD.

Spores are formed in the manner described by Harper for *Fuligo*, except that in *Lycogala* the spores at the periphery of the æthalium are latest to mature.

Some Geological Aspects of Artificial Drainage: G. G. WHEAT.

The Pleistocene Record of the Simpson College Well: JOHN L. TILTON.

This paper is a record of material found as an eighteen-inch well was bored one hundred and twelve feet through the Pleistocene deposits at Simpson College. It was accompanied by an oral description of variations found in other parts of Warren County.

The Aftonian Age of the Aftonian Mammalian Fauna: SAMUEL CALVIN.

Some Standardizing Tests of Stern's Tone Variator: R. H. SYLVESTER.

Discrimination Sensibility for Pitch within the Tonal Range: H. G. SCHAEFER.

The technique of past measurements on pitch discrimination within the tonal range has been overhauled within the last few years, and sources of error have been discovered. It has been the object of the present experiment to work under more perfect conditions and on a larger number of individuals, and from the results to obtain a more reliable curve.

The Technique of Pitch Discrimination Measurements: C. E. SEASHORE.

During the last few years, the technique of these measurements has been subjected to experimental criticism which has resulted in the rejection of numerous experiments, methods and results formerly credited. It has also resulted in aggressive, constructive work reducing the physical, physiological and psychological factors in the problem to a fair degree of control, which enables us to make our measurements reliable and to get a keener insight into the nature of the problem than has heretofore been obtained.

Some Recent Discoveries concerning Behavior of Platinum-iridium Wires: LEE P. SIEG.

Concerning a Study of Kerosene Oils by Physical Methods: G. W. STEWART.

Historical Sketch of Early Health Regulations in Iowa: L. S. ROSS.

Brief account of causes leading to establishment of rules and regulations. Early ordinances; diseases most feared. Danger from cholera in river towns.

Contributions to the Herpetology of Northwestern Iowa: ALEXANDER G. RUTHVEN.

Partial results of an expedition sent by the Museum of the University of Michigan to northwestern Iowa for the purpose of obtaining representatives of the fauna of the region. An analysis of this material shows that this fauna is composed of three elements, a wide-ranging one; an eastern one associated with the lowland habitats, and a western one associated with the upland habitats.

An Annotated Catalogue of the Recent Mammals of Iowa: T. VAN HYNING.

The Persistence of Certain Mollusks: B. SHIMEK.

A discussion of certain mollusks which appear in the Aftonian and have come down to us through the several succeeding interglacial periods to the present time.

The Development of the Posterior Lymph Hearts of the Loggerhead Turtle (Thalassochelys caretta): FRANK A. STROMSTEN.

The Development of the Sympathetic Nervous System in Birds: ALBERT KUNTZ.

This paper is an attempt to further exact knowledge concerning the histogenesis of the sympathetic nervous system, to extend the author's observations on the histogenesis of the sympathetic system in mammals, and to point out certain morphogenetic differences which occur in the development of the sympathetic system in birds and mammals, with a view to their phylogenetic significance.

During the business meeting the following resolutions were adopted:

"Recognizing the primal importance of the pub-

lic health, and the inefficiency of measures which are less than national in their scope,

"*Resolved*, that the Iowa Academy of Science hereby expresses its hearty approval of the bill (S 6049) now under the consideration of the national congress, for the establishment of a national department of health, presided over by a secretary who shall be a member of the president's cabinet."

"By virtue of the fact that there is now a general movement for the conservation of our natural resources, both by the national authorities and more recently by the state, therefore be it

"*Resolved*, that the Iowa Academy of Science in session hereby reaffirms its endorsement of the general movement toward the conservation of our forests, rivers, lakes and mineral resources by the national government."

The next annual meeting of the academy will be held at Coe College, Cedar Rapids.

L. D. Ross,
Secretary

Des Moines, Ia.

THE BOTANICAL SOCIETY OF WASHINGTON

The May meeting of the society was held at the Ebbitt House, May 28, 1910, at eight o'clock P.M.; President Wm. A. Taylor presided.

Dr. David Griffiths illustrated a method for making permanent records of the characters of the genus *Opuntia*. Large photographs (one half natural size) are taken and from the plates two prints are made, one on velox and a second on platinum paper. The latter is made very faint and is used as an outline by the field artist who reproduces the colors of the plant from living material.

The following papers were read:

Professor Charles Fay Wheeler: W. F. Wight. Published elsewhere in Science.

Starch Content of Leaves Dropped in Autumn: L. L. Harter.

Contrary to the accepted view that practically all food materials in leaves undergo translocation in autumn, the author found that dropped leaves of *Liquidambar*, *Ginkgo*, *Styrax* and some oaks contained starch in amounts varying from 6 to 14 per cent.

Facts Contributing to the Explanation of Grain Rust Epidemics: Edw. C. Johnson.

In this paper it was shown that wintering uredos, wind-blown uredospores or æcidiospores are usually present in sufficient quantities to start rusts every year. That uredospore germination and infection in many rusts takes place most easily at the relatively low temperatures of 60° to 70° F. was demonstrated. It was further shown that wheat is particularly susceptible to infection of *Puccinia graminis* at heading time. If this period is delayed by a late season, or is unduly lengthened by reason of low temperatures the number of spores falling on each plant is proportionately increased, and the rust given unusual chances to develop. Subnormal temperatures—especially cool nights with heavy dews—are exceedingly favorable to rust infection at this time, far more so than excessive rainfall due to sudden showers with periods of high temperatures between.

An analysis was made of climatological conditions over the middle northwest during 1903, 1904 and 1905, and it was demonstrated that although precipitation and relative humidity were greatest in 1905, both during the growing and heading period, stem rust was most severe in 1904 when temperatures averaged 3.5° F. subnormal over this region, this being considerably lower than temperatures in either 1903 or 1905.

On the Transmission of Characters without Expression in Vegetables: W. W. Tracy, Sr.

Red Narragansett, probably an aboriginal variety of sweet corn, was bred in one direction into Red Cory by crossing with an eight-rowed flint squaw corn of New England. From this was selected a White Cory which bred true with no trace of red for many years. From Red Narragansett was also obtained by selection Early Marblehead, and this it is surmised was carried to Russia by a missionary. Later Early Malakoff was imported from this part of Russia. This corn showed no traces of Red Narragansett. In an accidental cross of White Cory and this Malakoff corn there appeared thirteen plants which produced a corn like Red Narragansett, showing that the characters of the parent variety were carried hidden for many years, to appear again when the two strains were crossed.

A similar case of unexpressed transmission was noted in a variety of cabbage, the Early Winnigstadt, strains of which were established by selection in 1885. One of these strains showed a small percentage of Green Glaze cabbage which has been carried for twenty-five years, although no plant of Green Glaze has ever been allowed to furnish seed in this strain.

W. W. Stockberger,
Corresponding Secretary